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DOCUMENT-IDENTIFIER: US 5581297 A

TITLE: Low power video security monitoring system

DATE-ISSUED: December 3, 1996

INVENTOR-INFORMATION:

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APPL-NO: 08/ 367219 [PALM]
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FIELD-OF-SEARCH: 348/153, 348/152, 348/143, 348/151, 348/154, 348/363, 348/364, 348/365, 340/539, 340/538, 340/310, 345/179, 345/181, 345/183, 395/750, 395/550

PRIOR-ART-DISCLOSED:

U.S. PATENT DOCUMENTS

Search Selected Search ALL Clear

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ART-UNIT: 265

PRIMARY-EXAMINER: Chin; Tommy P.

ATTY-AGENT-FIRM: Schreiber; Donald E.

ABSTRACT:

If motion occurs in an area viewed by a lens (14) of a video camera (12), a video security monitoring system (10) establishes a communication link with a video monitoring facility and begins transmitting compressed video images of the area. The system (10) is fabricated from CMOS integrated circuits, and operates at a reduced clock frequency while motion is not detected. Reducing the clock frequency lowers the required power thus permitting operation of the system (10) on energy supplied by an ISDN basic access communication channel. If motion occurs, a digital video image compression subsystem (16) begins producing low quality compressed video data for transmission to the monitoring facility. If motion occurs in the central region of the area viewed by the lens (14), then the subsystem (16) produces a single high quality compressed video image. Commands transmitted from the monitoring facility to the video security monitoring system (10) may control its entire operation.

29 Claims, 2 Drawing Figures

L23: Entry 13 of 15 File: USPT Dec 3, 1996

DOCUMENT-IDENTIFIER: US 5581297 A
TITLE: Low power video security monitoring system

Abstract Text (1):
If motion occurs in an area viewed by a lens (14) of a video camera (12), a video security monitoring system (10) establishes a communication link with a video monitoring facility and begins transmitting compressed video images of the area. The system (10) is fabricated from CMOS integrated circuits, and operates at a reduced clock frequency while motion is not detected. Reducing the clock frequency lowers the required power thus permitting operation of the system (10) on energy supplied by an ISDN basic access communication channel. If motion occurs, a digital video image compression subsystem (16) begins producing low quality compressed video data for transmission to the monitoring facility. If motion occurs in the central region of the area viewed by the lens (14), then the subsystem (16) produces a single high quality compressed video image. Commands transmitted from the monitoring facility to the video security monitoring system (10) may control its entire operation.

Application Filing Date (1):
19950110

Brief Summary Text (4):
Well known in the art are video security systems that present an observer located at a video monitoring facility with a succession of images of different areas, each area being viewed by a lens of a different video camera. However, these video systems are completely passive in the sense that detecting an intrusion into the area viewed by the camera's lens remains the responsibility of the observer. That is, the video camera provides the observer with no assistance in detecting an intrusion. Thus, if the observer at the video monitoring facility is distracted or fails to notice the occurrence of an intrusion, no alarm will be raised. It is also possible that the occurrence of an intrusion might be missed because images of other areas are being presented to the observer at the instant the intrusion occurs. Furthermore, because the video signal from each video camera must be transmitted to the video monitoring facility by a wide bandwidth, coaxial cable, or by some other type of wide bandwidth, dedicated communication channel such as a microwave link, it is commercially impractical to distribute this type of video security system at sites randomly located within an extended geographic area, such as throughout a large city.

Brief Summary Text (6):
Recently, throughout the world, telephone systems have begun providing digital communication capability in accordance with the Integrated Services Digital Network ("ISDN") standard established by the International Telegraph and Telephone Consultative Committee ("CCITT"). Under this CCITT standard, a basic ISDN access consists of two full-duplex 64 kilobits per second ("kbps") digital data channels, called channel B1 and channel B2, plus another full-duplex 16-kbps digital channel, called a D channel. Under the CCITT standard, using time division multiplexing, all three of these digital data channels may be transmitted over a single pair of twisted wires, or over two pairs of twisted wires. While ISDN basic access was originally intended to provide voice and slow speed data communication services,

over the years developments in digital signal processing and compression techniques have advanced technology to the extent that compressed video data may now be transmitted using an ISDN basic access communication channel. These techniques have progressed to such an extent that there now exist several alternative video data compression techniques such as the CCITT H.261 picture phone standard, the Joint Photographic Experts Group ("JPEG") standard, and the Moving Picture Experts Group ("MPEG") standard that permit transmission of video images over an ISDN basic access communication channel. Furthermore, the CCITT has established a standard H.221 which permits intermixed transmission over an ISDN basic access communication channel of images compressed in accordance with both the H.261 picture phone standard, and images compressed in accordance with the JPEG standard.

Brief Summary Text (20):
A video security monitoring system in accordance with the present invention may also include a compressed data memory for temporarily storing compressed digital video data produced by the digital video image compression subsystem. A compressed data memory may be advantageously included in the video security monitoring system of the present invention to temporarily store compressed digital video data during an interval between detection of motion by the digital video image compression subsystem and establishment of an ISDN basic access communication link between the video security monitoring system and the video monitoring facility. If compressed digital video data has been stored in the compressed data memory, responsive to commands transmitted from an observer at the video monitoring facility to the video security monitoring system, the system may provide the observer with images of the area viewed by the camera's lens beginning at the instant at which the digital video image compression subsystem detects motion. Moreover, because the preferred embodiment of the compressed data memory retains compressed digital video data after an interruption of electrical power to the video security monitoring system, images stored in the compressed data memory may be retrieved and viewed long after their occurrence and storage.

Detailed Description Text (2):
FIG. 1 is a block diagram depicting a video security monitoring system in accordance with the present invention identified by the general reference character 10. The video security monitoring system 10 includes a video camera 12. The video camera 12 may be selected from among those provided by various manufacturers such as a model CCB-C35T sold by Sony Corporation of Japan. The video camera 12 includes a lens 14 that, in the illustration of FIG. 1, has adjustable iris, focus, and zoom. Depending upon the particular application for the video security monitoring system 10, the lens 14 of the video camera 12 may or may not include all of these features. The video camera 12 produces video timing signals and transmits them to a digital video image compression subsystem 16 via a video timing signals bus 18. The video timing signals present on the video timing signals bus 18 synchronize the operation of the digital video image compression subsystem 16 to that of the video camera 12. In synchronism with the video timing signals, the video camera 12 produces a video signal of an image of an area viewed by the lens 14 that is transmitted over a video signal bus 22 to the digital video image compression subsystem 16.

Detailed Description Text (8):
The video security monitoring system 10 may also include a compressed data memory 42 for temporarily storing compressed digital video data produced by the digital video image compression subsystem 16. The compressed data memory 42 may be advantageously included in the video security monitoring system 10 to temporarily store compressed digital video data during an interval between detection of motion by the digital video image compression subsystem 16 and establishment of the ISDN basic access communication link between the video security monitoring system 10 and the video monitoring facility. The inclusion of the compressed data memory 42 in the video security monitoring system 10 assures preservation of images beginning at the instant the digital video image compression subsystem 16 sensed movement.

Detailed Description Text (9):
Because the compressed data memory 42 exchanges data with the digital signal transmission interface and control 24 over the system bus 26, compressed digital video data stored in the compressed data memory 42 must first be transferred from the digital video image compression subsystem 16 to the digital signal transmission interface and control 24, after which the digital signal transmission interface and control 24 transfers the compressed digital video data to the compressed data memory 42. The compressed data memory 42 operates as a queue buffer with the most recent compressed digital video data replacing the oldest compressed digital video data previously stored in the compressed data memory 42. If commands received by the video security monitoring system 10 from the video monitoring facility request transmission of the compressed digital video data stored in the compressed data memory 42, then the digital signal transmission interface and control 24 retrieves the requested compressed digital video data from the compressed data memory 42 and transmits it to the video monitoring facility.

Detailed Description Text (14):
The video security monitoring system 10 may also include a serial control 66 for exchanging signals, via the camera controls signal bus 46, between the digital signal transmission interface and control 24 and a monitoring device (not illustrated in any of the FIGS.) external to the system 10. The serial control 66 preferably provides bidirectional interface 68, such as an RS232 or "S" interface, to permit two-way communication between the digital signal transmission interface and control 24 and the external monitoring device. For example, if the video security monitoring system 10 were installed out-of-doors, perhaps monitoring a construction site, the serial control might exchange signals between the digital signal transmission interface and control 24 and a weather station located at the construction site that senses atmospheric conditions such as wind speed.

Detailed Description Text (16):
The video security monitoring system 10 may also include a stylus 82 having a battery powered LED 84 whose infra red radiation may be directed toward the lens 14. If an individual appropriately holds the stylus 82 to direct light from its LED 84 toward the lens 14 while writing an identifying message, for example while writing their name, the video security monitoring system 10 may verify their identity. Such verification may be made either by visual observation of the image by an observer at the video monitoring facility, or by a computer program executed by a digital computer located at the video monitoring facility, or executed in the digital signal transmission interface and control 24 of the video security monitoring system 10.

Detailed Description Text (31):
The second strategy employed is to transmit control signals via the camera controls signal bus 46 to the video camera 12, to the digital video image compression subsystem 16, to the digital signal transmission interface and control 24, and if the video security monitoring system 10 includes a microphone 92, to the digital audio compression-decompression subsystem 96 causing them to reduce their clock speed. Because the entire video security monitoring system 10 is preferably fabricated using CMOS ICs, reducing the clock speed greatly reduces the amount of power required to operate the video security monitoring system 10. If the clock speed is reduced to one-half, the power consumed by the ICs included in the video security monitoring system 10 is reduced to approximately one-fourth of that consumed during full speed operation. If the clock speed is reduced to one-tenth, the power consumed is reduced to approximately one-hundredth of that consumed during full speed operation. While the entire video security monitoring system 10 consumes approximately fourteen watts of power when operating at full speed, the clock speed may be easily reduced to such an extent that the power consumed is significantly less than that provided by a ISDN basic access communication channel while maintaining full capability to detect motion occurring in the area viewed by

the lens 14.

Detailed Description Text (33):
If the digital video image compression subsystem operating at reduced speed detects movement in the area viewed by the lens 14, the microcomputer 152 then signals the various circuits in the video security monitoring system 10 to begin operating at full speed and capacity. Consequently, when the clock speed increases the digital signal transmission interface and control 24 commands the VC IC 134 and VP IC 136 to begin producing digital video data compressed in accordance with the CCITT H.261 standard. If motion is detected, the microcomputer 152 also immediately causes the ISDN interface IC 162 to place a telephone call to the video monitoring facility. After the video security monitoring system 10 is in communication with the video monitoring facility it will begin transmitting compressed digital video data there. At the same time, commands may be sent from the video monitoring facility to the video security monitoring system 10 for controlling its operation.

Detailed Description Text (38):
If the video security monitoring system 10 includes the microphone 92, the ADC 182 receives the audio signal from the microphone 92 via the audio input line 94. The ADC 182 then digitizes this audio signal to generate digitized audio data that it transmits to the DSP IC 172 via a digitized audio input data bus 186. Similar to the VC IC 134 and the VP IC 136, the DSP IC 172 monitors the digitized audio data to detect if there is a change in the sound about the video security monitoring system 10. If a change in sound occurs, the DSP IC 172 transmits data over the system bus 26 to the digital signal transmission interface and control 24 notifying it of the event. The microcomputer 152 responds to this notification by transmitting control signals to the digital audio compression-decompression subsystem 96 which increases the clock speed of the DSP IC 172 and cause it to begin converting the digitized audio data into compressed digital audio data and transmitting the compressed digital audio data to the digital signal transmission interface and control 24 via the system bus 26. The DSP IC 172 compresses the digitized audio data in accordance with one of the audio compression standards, such as the CCITT standard G.711 or G.722, that adapt audio data for transmission over an ISDN communication channel. Concurrent with initiating production of compressed digital audio data by the digital audio compression-decompression subsystem 96, the microcomputer 152 also places a telephone call to the video monitoring facility, and begins storing the compressed digital audio data in a queue buffer on the compressed data memory 42 if one is included in the video security monitoring system 10.

CLAIMS:

1. A video security monitoring system comprising:

a video camera for producing a video signal from an image of an area viewed by a lens of said video camera, said video camera including an iris control;

a digital video image compression subsystem for receiving the video signal from said video camera, for digitally processing the video signal to determine if any motion is occurring in the area viewed by the lens of said video camera, for converting the video signal into compressed digital video data that provides an image of the area viewed by the lens of said video camera, and for transmitting the compressed digital video data;

a digital signal transmission interface and control for controlling operation of said video camera and said digital video image compression subsystem, for receiving the compressed digital video data from said digital video image compression subsystem, and for transmitting the compressed digital video data from said video security monitoring system to a remote video monitoring facility via a communication channel if said digital video image compression subsystem determines

that motion has occurred in the area viewed by the lens of said video camera, said digital signal transmission interface and control also managing power consumption by said video security monitoring system by causing said video camera and said digital signal image compression subsystem to operate at a slower clock speed when motion is not present in the area viewed by the lens of said video camera and to operate at a faster clock speed upon detecting motion in the area viewed by the lens of said video camera; and

a camera controller for effecting changes in settings of the iris control of said video camera to compensate for changes in video camera sensitivity resulting from operation of said video camera at different clock speeds in effecting power management of said video security monitoring system.

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L27: Entry 1 of 1 File: USPT Aug 30, 1994

US-PAT-NO: 5341916
DOCUMENT-IDENTIFIER: US 5341916 A
** See image for Certificate of Correction **

TITLE: Controlled spacing induction

DATE-ISSUED: August 30, 1994

INVENTOR-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY
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APPL-NO: 08/ 095933 [PALM]
DATE FILED: July 22, 1993

PARENT-CASE:
CROSS-REFERENCE TO RELATED APPLICATION This application is a continuation of application Ser. No. 08/036,226, filed Mar. 24, 1993, now U.S. Pat. No. 5,267,638 which is a continuation of application Ser. No. 07/743,506, filed Aug. 9, 1991, now abandoned, which is a continuation-in-part of application Ser. No. 07/597,103, filed Oct. 12, 1990, now U.S. Pat. No. 5,038,911, which is a continuation of patent application Ser. No. 07/352,002, filed May 15, 1989, now abandoned, which is a continuation-in-part of application Ser. No. 07/311,826, filed Feb. 16, 1989, now abandoned.

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US-CL-CURRENT: 198/460.1; 198/572

FIELD-OF-SEARCH: 198/459-461, 198/572

PRIOR-ART-DISCLOSED:

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Search Selected Search ALL Clear

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ART-UNIT: 311

PRIMARY-EXAMINER: Dayoan; D. Glenn

ATTY-AGENT-FIRM: Price, Heneveld, Cooper, DeWitt & Litton

ABSTRACT:

A conveyor system including an induction subsystem for producing a desired spacing between packages as they are discharged from a single induction line. The induction line includes a conveyor and a speed controller for controlling the running speed of the conveyor in a manner that discharges a package as close as possible to a time necessary to provide a desired gap with a previously-discharged package. A control monitors movement of packages on the conveyor and includes a device for determining a speed adjustment required for each speed controller to cause the packages on the line to reach the discharge conveyor as close as possible to the desired time. Speed adjustments include a constant acceleration to a higher discrete speed or deceleration to a lower discrete speed from a nominal discrete speed with a return to the nominal speed prior to discharging the package. In one embodiment, the induction line is operated by two servo-controlled motors, with the speed of the downstream motor being controlled in a manner that will provide desired spacing between inducted packages and with the speed of the upstream motor being controlled in o proportion to the speed of the downstream motor. This provides an initial controllable gap between packages to reduce the range of gaps experienced by the induction control.

35 Claims, 18 Drawing figures

L27: Entry 1 of 1 File: USPT Aug 30, 1994

DOCUMENT-IDENTIFIER: US 5341916 A
**** See image for Certificate of Correction ****
TITLE: Controlled spacing induction

Abstract Text (1):
A conveyor system including an induction subsystem for producing a desired spacing between packages as they are discharged from a single induction line. The induction line includes a conveyor and a speed controller for controlling the running speed of the conveyor in a manner that discharges a package as close as possible to a time necessary to provide a desired gap with a previously-discharged package. A control monitors movement of packages on the conveyor and includes a device for determining a speed adjustment required for each speed controller to cause the packages on the line to reach the discharge conveyor as close as possible to the desired time. Speed adjustments include a constant acceleration to a higher discrete speed or deceleration to a lower discrete speed from a nominal discrete speed with a return to the nominal speed prior to discharging the package. In one embodiment, the induction line is operated by two servo-controlled motors, with the speed of the downstream motor being controlled in a manner that will provide desired spacing between inducted packages and with the speed of the upstream motor being controlled in o proportion to the speed of the downstream motor. This provides an initial controllable gap between packages to reduce the range of gaps experienced by the induction control.

Brief Summary Text (5):
One technique for establishing gaps between packages is to discharge the stream of packages from an accumulating conveyor onto a series of belts of increasing speed. As the package discharges from one belt to the next, it is accelerated and spaced from the subsequent package. The difficulty with such a system is that the gap is proportional to the length of the package. The result is that, if system parameters are selected to properly gap the smallest packages, wasteful large gaps will occur between longer packages.

Brief Summary Text (6):
Another difficulty that must be addressed in such a system is the merging of packages into a single file for sortation. Because warehouse floor space is usually at a premium, it is disadvantageous to provide an accumulation conveyor between a completely merged line of packages and the sortation subsystem because the required length of the accumulation conveyor would be great. Accordingly, it may be desirable to separate the infeed lines into two or more feed lines each having a short accumulation conveyor and provide the final package merge immediately upstream the sortation subsystem. Multiple accumulation conveyors feeding the sortation subsystem can run at slower speeds than would be required to deliver the same volume of packages from a single accumulation line. This also increases the life expectancy of the conveyor and reduces noise.

Brief Summary Text (9):
The invention may be embodied in a conveyor system having a sortation subsystem adapted to sorting packages onto selected spurs, an induction subsystem adapted to

discharging pac[illegible]s to the sortation subsystem [illegible] desired spacing between packages and a control. According to one aspect of the invention, the induction subsystems include at least one induct control conveyor and an initial gap control conveyor located upstream of the induct control conveyor. The control includes means for controlling the speed of the induct control conveyor to create the desired spacing between packages on the sortation subsystem and means for controlling the speed of the initial gap control conveyor in a manner that will provide controlled spacing between packages on the induct control conveyor.

Brief Summary Text (10):
The invention may advantageously be implemented by controlling the speed of the initial gap control conveyor as a function of the speed of the induct control conveyor and a variable speed ratio selected to provide the controlled spacing, or initial gap, between packages.

Brief Summary Text (11):
In an illustrated embodiment, a first servo drive is provided for controlling the speed of the induct control conveyor and a second servo drive is provided for controlling the speed of the initial gap control conveyor. The control includes a first selecting means for selecting the speed of the induct control conveyor to create the desired spacing between packages received on the sortation subsystem and a second selecting means for selecting the ratio of speeds between the two conveyors required to perform the initial gapping function. The control establishes the speed of the initial gap control conveyor as a function of the speed selected by the first selecting means for the induct control conveyor and the ratio selected by the second selecting means. In this manner, the relationship between the induct control conveyor and the initial gap control conveyor is that of master/servant with the relationship being variable and selectable by the control means in a unique manner. The desired gaps between packages discharged to the sortation subsystem are defined between trailing edges of leading packages and leading edges of following packages. The initial gap between packages on each induct control conveyor is established, according to another aspect of the invention, with respect to the longitudinal centerlines of leading and following packages. Preferably, a constant center-to-center initial gap is provided between packages. Where packages are merged from plural induct control conveyors, the initial gap is selected as a function of the time it takes an induct control conveyor to decelerate to its slowest speed. This initial gap is sufficient to provide complete control over any package on the conveyor.

Brief Summary Text (12):
According to another aspect of the invention, the induction subsystem is operated at a first line speed and the sortation subsystem is operated at a second line speed that is different from the first line speed. Control means are provided for controlling the induction subsystem in a manner that will cause desired gaps between packages after the packages are received by the sortation subsystem. This aspect of the invention advantageously allows the induction subsystem to operate at a slower, and hence, more accurate speed, while creating desired gaps between the packages at the location where such gaps are necessary. This is at the sortation subsystem wherein sufficient gaps are necessary in order to facilitate sortation of the packages but excessive gaps are undesirable because of the resulting reduction in through-put of the system. This aspect of the invention may be embodied in a conveyor system in which the control actuates speed control means as a function of the ratio of the discharge speed of the induction subsystem to the speed of the sortation subsystem, as well as the desired gaps between the packages and the length of each package.

Drawing Description Text (7):
FIG. 5 is a logic flow diagram of the program used to implement conveyor speed changes of the subsystem in FIG. 2;

Drawing Description Text (8):
FIG. 6 is a diagram of the conveyor speed for a one-line induction subsystem;

Drawing Description Text (9):
FIG. 7 is a diagram of the conveyor speed for a two-line induction subsystem;

Drawing Description Text (14):
FIG. 12 is a diagram of the conveyor speed for the induct control and initial gap control conveyors of a conveying line portion of the subsystem in FIG. 9;

Drawing Description Text (16):
FIG. 14 is a plan view illustrating the effect of a speed change at the transition between an induction subsystem and a sortation subsystem.

Detailed Description Text (3):
Conveyor system 10 further includes a multiple line induction subsystem 30 which, in the illustrated embodiment, includes a first induction line 32 and a second induction line 34. Although the invention is illustrated in an induction subsystem having two induction lines, it is capable of implementation in a subsystem having only one line or more than two induction lines. Particular advantages of the invention may be realized in a subsystem having only one induction line and the number of plural induction lines to which it may apply is theoretically unlimited. Feed line 18a is joined with first induction line 32 by an accumulator 36 which accumulates product awaiting entry to first induction line 32. An accumulator 38 is positioned between infeed line 18b and second induction line 34. An alignment conveyor 40 receives packages discharged from induction lines 32 and 34 and provides a guide bar 42 for laterally shifting packages discharged from line 34 into a single file with packages discharged from line 32. Packages are discharged from alignment conveyor 40 onto sortation conveyor 22. Induction subsystem 30 further includes a control 44 which receives inputs from input devices associated with induction lines 32 and 34 and produces outputs for controlling the speeds of lines 32 and 34. Control 44 may additionally interface with sortation controller 28 and other control portions of the conveyor system 10.

Detailed Description Text (4):
Each induction line of multiple line induction subsystem 30 includes four belt conveyors designated 46a through 46d for first induction line 32 and 48a through 48d for induction line 34 (FIG. 2). Belt conveyor 46c is a metering conveyor and is driven from an AC servo motor and reducer assembly 50 having a holding brake (not shown). Belt conveyor 48c is also a metering conveyor and is independently driven by AC servo motor and reducer assembly 52. Belt conveyor 46b is driven by speed reducer 54a mechanically coupled with belt 46c and belt 46a is driven by speed reducer 54b driven from conveyor 46b. Speed reducers 54a and 54b are each configured to reduce the speed of the driven conveyor to 70% of the driving conveyor. In this manner, belt conveyor 46b is driven at 70% of the speed of conveyor 46c and conveyor 46a is driven at 70% of the speed of conveyor 46b. Likewise, belt conveyor 48b is driven at 70% of the speed of belt conveyor 48c by speed reducer 56a and belt conveyor 48a is driven at 70% of the speed of belt conveyor 48b by speed reducer 56b.

Detailed Description Text (5):
Belt conveyors 46d and 48d receive packages from conveyors 46c and 48c respectively and are operated at fixed speeds identical with alignment conveyor 40 independently of the speeds of conveyors 46a-46c and 48a-48c. In the illustrated embodiment, conveyors 40, 46d and 48d are driven at 350 feet per minute, which is the same speed as sortation conveyor 22, and metering conveyors 46c and 48c are independently operable at three discrete running speeds: 0 fpm, 350 fpm and 600 fpm. Although conveyors 46c and 48c are operable at three discrete running speeds, servo motors 50 and 52 are capable of infinitely variable speed adjustment over a wide range of speeds and are controlled in a manner that provides constant

acceleration (a[illegible]eceleration) between discrete[illegible]nning speed levels. The acceleration level is preselected to avoid overturning a package and avoiding slippage between the packages and the belts.

Detailed Description Text (6):
Control 44 includes a microcomputer 58 having an input circuit board 60 which receives parallel inputs 62 from an input module 64. Microcomputer 58 additionally includes an output circuit board 66 which provides parallel outputs 68a to an output module 70a and parallel outputs 68b to an output module 70b. Input board 60 is a 48 channel parallel input card having a standard bus interface with microcomputer 58. Output board 66 is a 48 channel parallel output card having a standard bus interfaced with microcomputer 58. Output module 70a provides output signals on four parallel lines 72a through 72d that are presented to a servo interface circuit 76 as selection lines for one of four running speeds for servo motor 52, although only three running speeds are used in the illustrated embodiment. Output module 70b provides output signals on lines 74a through 74d that are presented to a servo interface circuit 78 as running speed selection lines for servo motor 50. Microcomputer 58, in the illustrated embodiment, is a commercially available microcomputer sold by Cubit and based on a 16 bit Intel 80186 microprocessor. Input module 64 and output modules 70a and 70b may be any suitable commercially available interface modules.

Detailed Description Text (8):
A block diagram for servo interface circuits 76 and 78 is illustrated in FIG. 3. The signals on speed-select lines 72a through 72d or 74a through 74d are optically isolated and provided on lines 93a-93d to a priority encoding circuit 94. Priority encoding circuit 94 compares the current speed-select inputs with the immediately previous speed-select inputs and selects a new running speed on a priority basis, with higher speeds having priority. Priority encoding circuit 94 interprets the condition of an absence of input signals on lines 93a-93d as a zero speed, or brake selection command. Outputs from priority encoding circuit 94 are provided on lines 95a-95c to a level-select circuit 96 which also receives analog voltage signals on lines 97a-97d from manually-settable voltage setting devices 98a through 98d, to establish the values of the four selectable running speed levels. Output 99 from level-select circuit 96 is the voltage level set by the adjusting means 98a-98d which corresponds to the speed selected by encoding circuit 94 and provides an input signal to a ramp generator and driver circuit 100.

Detailed Description Text (9):
Ramp generator and driver circuit 100 additionally receive manually-settable ramp adjustment inputs from devices 102a and 102b. Ramp adjustment devices 102a and 102b establish the values of the constant slopes of the analog voltage ramps between speed changes, which, in turn, provide constant positive acceleration to increasing discrete speed levels and negative acceleration to decreasing discrete speed levels. The settings of devices 102a and 102b thus establish the acceleration forces exerted on the packages. In the preferred embodiment, adjustment devices 102a and 102b are set to produce a maximum acceleration/deceleration force on the packages that will not topple packages on the conveyor. Ramp generator and driver circuit 100 produce an analog speed signal output 104 which is provided on line 80 or 86 to the respective servo motor controller. Servo interface circuit 76, 78 additionally receives a servo run interlock input 106 from other portions of the conveyor system to actuate the servo interface circuit. An enable logic circuit 107 responds to a command from priority encoding circuit 94 and produces an enable output 108 to release the brake (not shown) for the respective servo motor 50, 52 when a nonzero speed is selected. When, however, a zero speed is being requested, priority encoding circuit 94 causes enable logic circuit 107 to remove the enable output 108 in order to apply the brakes to the particular induction line provided that a command from ramp generator and driver circuit 100 indicates that the drive signal produced on output 104 is very close to zero speed. This causes the brakes to be applied when there is a significant interruption in supply of packages to a

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